PROGRAM ANNOUNCEMENT TO
DEPARTMENT OF ENERGY LABORATORIES

NUMBER
FP2003

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Coordinated by:	The American Forest and Paper Association 1111 19th Street, NW Suite 800 Washington, DC 20036 Per Agreement with DOE "Agenda 2020 - Forest Products Industries of the Future"

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SUMMARY

The U.S. Department of Energy (DOE) is seeking proposals for cost-shared research and development of technologies which will reduce energy consumption, enhance economic competitiveness, and reduce environmental impacts of the Forest Products Industry. The research is to address research priorities in the higher value through sustainable forestry, gasification, fiber modification and VOC and HAP emission technology areas. Approximately $1,000,000 in federal funds is expected to be available to fund the first year of selected research efforts. DOE anticipates these selected research efforts each being $500,000 to $700,000 per year with a duration of three to five years. **Note that proposals selected by DOE for funding must have documentation to support substantial direct energy savings to the forest products industry.**

Out-year funding for selected projects shall depend upon availability of funds, as well as upon satisfactory progress towards project goals and deliverables. Total available funds for future years is anticipated to be similar to first year funding.

Collaborations between industry, university, and National Laboratory participants are encouraged. **Emphasis should be placed on looking across traditional technology lines toward innovative, integrated, crosscutting solutions to the needs described.**

Successful proposers will be required to submit quarterly, annual, and final reports to DOE and attend an annual task group meeting and make a presentation on the status of their work.

DOE may continue funding the work if the proposer demonstrates sufficient progress in the research effort and has submitted timely and informative reports.

After the feasibility of the technology is proven on selected projects, AF&PA is available to assist in identifing members for an industry advisory group, to assist the researcher in getting industry input to establish the greatest benefit of the work to the forest products industry.

CONTINUATION OF EXISTING PROJECT

Individuals with **existing** Department of Energy “Agenda 2020 - Forest Products Industries of the Future” projects may submit a proposal for the continuation of an existing project under this annoucement. Continuation proposals may be be submitted for any technology area.

COST SHARE

Only proposals submitted with the following minimum cost share requirements will be considered:

1) For feasibility: a 20% minimum cost share from non-federal sources (i.e., Agenda 2020 funding from DOE will provide only 80% of the total project costs, at most).

2) For projects that are in the development phase with a proven feasibility: a 30% minimum cost share from non-federal sources.

3) For projects involving commercial demonstration of technologies: a 50% minimum cost share from non-federal sources.

4) A minimum of 20% of the annual project cost must be cost shared that year, the total cost shared must be committed by project completion.

Cost share contributions need not be monetary (e.g., in-kind contributions are allowed). Industrial and/or supplier involvement and cost sharing above the required minimums are strongly encouraged. Cost share may not be other federal funding.

ELIGIBLE PROPOSERS

Proposals are encouraged from national laboratories with partners from the forest products industry and their suppliers, universities, other national laboratories and small businesses. **Single organization awards will not be considered.** Preference will be given to collaborations that are organized to facilitate technology transfer to the private sector, promote commercialization, and enhance U.S. competitiveness.

Member companies of AF&PA will not be eligible for award under this announcement.

Field Work Proposals (FWP) will be required only for those projects selected by DOE for funding.

QUESTIONS AND ANSWERS

Questions regarding this program announcement may be submitted to David Robertson, by e-mail: robertdw@id.doe.gov no later than January 8, 2002. Questions and answers to the questions will be posted to the www.oit.doe.gov/forest Website by January 29, 2002.

PROPOSALS

The proposal is to be prepared for the complete project. A separate proposal should be prepared for each project (i.e., do not combine two or more projects in one proposal).

Proposals submitted in response to this program announcement **shall not contain trade secrets and/or privileged or confidential commercial or financial information** which the proposer does not want used or disclosed. Proposals marked as containing such information will **not** be reviewed.

Technical proposals must not exceed 5 pages excluding summary page and attachments. Pages beyond the 5-page limit will not be evaluated. All proposals must include Attachment 7 and industry letters of support as attachments. **Proposals failing to submit Attachment 7 and industry letters of support will not be considered for selection. Attachment 7 documents the direct energy savings of the proposed scope of work.**

Applications must be submitted on standard 8-1/2" x 11" letter size paper. Margins on all four sides must not be smaller than 1"; font size must not be smaller than 11 point Arial or equivalent. The front and backsides of a single sheet are counted as 2 pages.

DOE will notify proposers regarding projects selected for funding in mid to late July 2002.

Successful proposers will have to prepare and submit a Field Work Proposal and may be required to prepare a two-page nonproprietary project fact sheet of the proposed project including project benefits suitable for public release, before award and updated on an annual basis.

PROPOSAL DUE DATES

Proposals shall be submitted by 5:00 p.m. EST on April 15, 2002. Ten (10) copies of the proposal must be submitted.

Caution: Applicants assume full responsibility for insuring that the proposal is received at the specified place by the specified time and date and with the specified number of copies.

SUBMITTAL ADDRESS

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Section I: Supplementary Information

A. Background

In 1994, the American Forest & Paper Association (AF&PA released Agenda 2020: A Technology Vision and Research Agenda for America's Forest, Wood, and Paper Industry, which outlines the research needs of the forest products industry to allow it to pursue a sustainable future. At that time the AF&PA and the Department of Energy (DOE) signed a compact to implement this research agenda. In 1996, the industry organized a process, under the aegis of the AF&PA Chief Technology Officers (CTO) Committee, to assist DOE in identifying research projects most important to the industry's Agenda 2020 Vision. Since that time, over 100 projects identified through this process have received DOE funding.

Agenda 2020 identified six areas appropriate for precompetitive research: sustainable forestry, environmental performance, energy performance, capital effectiveness, recycling and sensors and control. Industrial task groups were organized, reporting to the CTO Committee to work with the federal government to implement a research program in support of the Agenda 2020 Vision. Annually, the task groups identified areas of greatest potential value for precompetitive research, and defined technology gaps in the U.S Forest Products Industry's research activities. Collaboration between universities, research institutes, national laboratories, and industry associations was highly encouraged and valued.

In May 2001 the CTO committee convened a technical summit to re-evaluate the program and established that a strong, focused, innovative, pre-competitive and collaborative technology program in partnership with government is still needed and essential. This is important in order that the Forest, Wood, and Paper Industry can maintain its competitiveness, improve its capital effectiveness, become an increasingly attractive place for the best and brightest people to work, and continue to provide the world with essential, innovative and environmentally compatible products from renewable and reusable raw materials.

The Summit attendees defined the technology gaps facing the industry and consolidated these into six strategic platforms and focused on the technology opportunities to close these gaps.

Strategic Platforms:

High Value Raw Material Supply

Significantly Reduced Manufacturing Costs

Technologically advanced workforce

Environmental performance

Energy performance

New forest based materials

These strategic platforms as well as the incorporated technology areas are more fully described on DOE's Office of Industrial Technologies website at www.oit.doe.gov/forest.

B. Project Description

This solicitation seeks research proposals to address four of the research priorities identified at the Technology Summit, these are: higher value raw materials through sustainable forestry; gasification; fiber modification; and VOC and HAP emission technology areas. **DOE will only consider proposals that lead to substantial energy savings for funding.** The Agenda 2020 CTO Committee will seek funding sources other than DOE for the technology elements that do not lead to substantial energy savings. Proposals should emphasize connections between technology elements to address as complete a solution to the needs defined as possible. Partnering between R&D institutions is strongly suggested.

High Value Raw Material Supply Strategic Platform-Higher Value Through Sustainable Forestry Technology Area

Precompetitive research, development and demonstration proposals are requested for projects to produce low cost, superior raw material for existing and new higher value products. This technology area consists of the following six technology elements:

1. Developing information on specific wood structure and property relationships as they affect the quality of specific wood and paper products.
2. Identifying the range of natural variability in trees most important to existing or potentially new wood or paper products, and determining the extent to which these wood property traits are subject to genetic and environmental control.
3. Developing techniques to improve wood properties through genetic manipulation with a focus on the functional genomics of wood formation and wood quality in model tree species.
4. Developing cost effective, reliable, high throughput techniques and sensors for rapidly determining specific wood properties in the forest or at the mill.
5. Developing sensors, information, logistics technologies, and computational models to achieve a) efficiencies in timber harvesting and transportation; b) inventories capable of delivering just in time data on wood ready-for-harvest at stand and sub-stand levels of resolution and c) efficiencies in manufacturing processes based on greater knowledge of raw material characteristics relative to end product quality specifications.
6. Identifying breakthrough opportunities for new products or manufacturing processes based on novel wood properties produced through biotechnology.

Additional information is provided for the High Value Raw Material Supply Strategic Platform-Higher Value Through Sustainable Forestry Technology Area in Attachment 1.

Energy Performance Strategic Platform-Gasification Technology Area

Precompetitive research, development and demonstration proposals are requested in the six technology elements listed below:

1. Fuels Chemistry
2. Containment
3. Mill Integration Issues (including steam, power, pulping and causticizing)

4. Process Control and Optimization
5. Assurance and Education
6. Field Support

Additional information is provided for the Energy Performance Strategic Platform-Gasification Technology Area topic in Attachment 2.

Significantly Reduced Manufacturing Costs Strategic Platform-Fiber Modification Technology Area
Precompetitive research, development and demonstration proposals are requested for improvements in fiber bulk or surface characteristics to provide new and enhanced sheet structures and/or lower material costs. This technology area consists of the following eight technology elements:

1. Biotechnology
2. Process Improvement
3. Genetic Fiber Modification
4. Chemical or Enzymatic Fiber Modification
5. Mechanical Fiber Modification
6. New Forest Based Composite Materials
7. Fibrous Fillers
8. Highly Sensitive Chemical and Biological Methods to Prepare Fiber Supplies for Paper Manufacture

Additional information is provided for the Significantly Reduced Manufacturing Costs Strategic Platform-Fiber Modification Technology Area topic in Attachment 3.

Environmental Performance Strategic Platform-VOC and HAP Technology Emission Area
Precompetitive research, development and demonstration proposals are requested for low cost methods for controlling VOC and HAP emissions from pulp, paper, and paperboard mills and wood products facilities. This technology area consists of the following four technology elements:

1. The development of trees with reduced amounts of VOC and HAP precursors.
2. Production technologies (perhaps at low temperatures) that minimize the conversion of VOC and HAP precursors, or which use less VOC- and HAP- generating materials.
3. Methods to capture VOCs and HAPs that yield competitively priced by-products or fuels.
4. High efficiency VOC and HAP destruction technologies that are less costly and more resource efficient than thermal oxidation technologies.

Additional information is provided for the Environmental Performance Strategic Platform-VOC and HAP Technology Emission Area topic in Attachment 4.

SECTION II: APPLICATION REQUIREMENTS

Each application must contain the information requested and use the format described in Attachment 5.

SECTION III: Proposal Evaluation

A. Technical Review and Selection Criteria

Proposals will be rated by the merit review committee and those applicants with the highest scores may be contacted by the merit review committee for clarifications before the committee makes their final recommendation to the Selection Official. Clarifications may be done in person, by videoconference or teleconference.

Only those proposals which meet all of the requirements of this annoucement will be considered for selection. Selections will be made in accordance with the following selection criteria and programmatic considerations. All proposals will be evaluated and point-scored in accordance with the following criteria. The proposals must be fully responsive to each of the criteria.

Criterion 1 - Energy Benefits (30 points): Energy benefits will be evaluated considering the potential for the proposed technology to contribute to the reduction of the overall energy consumption and the reduction in the use of fossil based feedstock energy in the U.S. as compared to the current commercial technology to produce the same or similar product(s)

Criterion 2 - Technical Merit (25 points): The technical merit of the proposal will be evaluated considering: a) the responsiveness of the proposal to address the priority goal of bringing emerging technologies into use by the forest products industry; b) the responsiveness of the proposal to integrate across identified technology elements, c) clarity, completeness, and adequacy of the statement of objectives; d) the technical merit and feasibility of the proposed work (i.e., is it based on sound scientific/engineering principles and on an understanding of current state of the art in the industry); and e) the adequacy and appropriateness of the project plan, principal milestones, decision points, time for each task, and the planned assignment of responsibilities and level of manpower to complete the research.

Criterion 3 - Project Plan, Management Plan, and Team Technical Capabilities (25 points): This will be evaluated based on; a) the completeness and appropriate timing in the project plan; b) the degree of coordination, interaction, and adequacy of the overall project management plan across all the efforts, disciplines, partners, and objectives of the project; c) the overall breadth and depth of multi-disciplined capabilities to achieve all the project objectives, including the project team's characteristics that make them well suited to successfully develop and enable commercialization of the technology; d) the adequacy and applicability of available facilities; e) the breadth and depth of the collaboration across industry, academia and other partners.

Criterion 4 - Economic Benefits (10 points): Economic benefits will be evaluated considering: a) the general applicability, timeliness, and economic viability of the proposed technology (i.e., probability of commercial application); b) the size of the potential economic impact (i.e. potential market size); and c) the potential for enhancing the economic competitiveness of the domestic industry.

Criterion 5 - Environmental Benefits (10 points): Environmental benefits will be evaluated considering the potential for the proposed technology to contribute to the reduction of the overall environmental impact reduction in the U.S. as compared to the current commercial technology to produce the same or similar product(s).

B. Programmatic Selection Consideration

In conjunction with the evaluation results and rankings of individual applications, the Government will make selections for negotiations and planned awards from among the highest ranking applications, using the following programmatic considerations.

1) Addresses the needs stated in this solicitation from the forest products industry technology summit.

2) Programmatic goals include the desire for a portfolio of research projects balanced with respect to; short-term vs. long-term research, commercialization efforts and regional considerations.

3) The technologies have potential to result in significant improvements in energy efficiency, environmental performance, and economic competitiveness across the industry.

4) The total proposed cost of the project will not be point scored. Applicants are advised, however, that not withstanding the lower relative importance of the cost considerations, the evaluated cost may be the basis for selection. An award will not be made to an applicant whose proposal requires DOE funding in an amount that exceeds the DOE funding available.

Attachment 1

High Value Raw Material Supply Strategic Platform- Higher Value Through Sustainable Forestry Technology Area

This solicitation seeks proposals from research organizations that are to work on a comprehensive national program of research that will lead to new technologies for the wood products industry. It addresses two issues, one of importance to the industry and one of national importance.

A critical need for the paper and related wood products industry in North America, if it is to remain competitive in a world economy, is to be able to produce low cost, superior raw material for existing and new higher value products. With populations increasing and product specifications becoming more exacting, more wood will need to be produced on fewer acres, and that wood needs to be engineered to meet specific product characteristics. The public is increasingly demanding protection of natural forests for environmental and recreational purposes. Existing plantations will need to become more productive and will need to be viewed as factories producing specific fibers for specific end-product needs.

Advances in genetics, silviculture, and biotechnology can now be harnessed to obtain more uniform wood with properties that meet the specific needs of products being produced at any time. This, in turn, will reduce energy and chemical costs in the manufacturing process. The ability to produce low cost wood with superior end use properties will also create opportunities for producing an array of new forest-based products.

In addition, it is in the national interest (Executive Order 13134, Developing and Promoting Biobased Products and Bioenergy, August 1999) to be able to capitalize on our resource base to produce products that are bio-based and that move away from products produced from petroleum and other non-renewable resources. Research supported under this solicitation will permit all of the wood resource requirements of consumers to be sustainably met on no more than 20% of the forested land area of the United States, leaving the remaining natural forests available for environmental, recreational, and other purposes.

PROGRAM DESCRIPTION

The program consists of six integrated components. The six components are:

1. Developing information on specific wood structure and property relationships as they affect the quality of specific wood and paper products.
2. Identifying the range of natural variability in trees most important to existing or potentially new wood or paper products, and determining the extent to which these wood property traits are subject to genetic and environmental control.
3. Developing techniques to improve wood properties through genetic manipulation with a focus on the functional genomics of wood formation and wood quality in model tree species.
4. Developing cost effective, reliable, high throughput techniques and sensors for rapidly determining specific wood properties in the forest or at the mill.

5. Developing sensors, information, logistics technologies, and computational models to achieve a) efficiencies in timber harvesting and transportation; b) inventories capable of delivering just in time data on wood ready-for-harvest at stand and sub-stand levels of resolution and c) efficiencies in manufacturing processes based on greater knowledge of raw material characteristics relative to end product quality specifications.
6. Identifying breakthrough opportunities for new products or manufacturing processes based on novel wood properties produced through biotechnology.

The program will produce both short term and long-term benefits to the industry. In the short run, manufacturers will be able to produce more consistent, higher quality products using less inputs by being able to better match product needs with wood properties. In the longer run, biotechnology research strategies and tree improvement programs will be guided by specific wood property requirements. Also, manufacturing processes will be modified to optimize the raw material inputs, requiring less chemicals and energy.

An important information gap to providing low cost wood with superior properties for both existing and new products is in the area of wood structure and material property relationships. Not enough is known about the effects of fiber morphology, wood anatomy, and chemical composition on specific end-use properties of paper and solid wood products. Understanding structure/property relationships is critical to being able to engineer superior low cost forest-based raw materials.

Similarly, not enough is known about the degree to which tree species of major commercial value vary in terms of exhibiting specific properties of interest to manufacturers. Wide variation in such factors as height growth, vigor, and insect and disease resistance has been found in nature in such important tree species as loblolly pine. Tree improvement programs have capitalized on this natural variation for decades by breeding trees with desired characteristics. Variation in chemical composition and physical properties also exists in naturally growing trees, but little attention has been given to developing plantations with these specific characteristics. An important information gap is the identification of the range of natural variation of important wood structure and properties for the major commercial tree species. Clearly, this information gap is closely linked with the lack of information on property/product relationships described above.

Also needed is information about the genetic and environmental mechanisms that control specific wood properties. If the genetic basis for control of these properties can be identified, then both applied tree breeding strategies and biotechnology research can be directed to producing these properties. As well as understanding the genetic variation, it is also important to develop techniques to actually improve property traits through genetic manipulation, to that end an understanding the functional genomics of wood formation in model tree species is critical to success.

The possibility of tailoring plantations to maximize specific wood structures or properties opens possibilities for developing new forest-based materials and products, including transformation of biomass to commercially useful polymers and other chemicals. This is of national importance since it will allow for the replacement of petrochemical based materials by renewable resources in the future.

In order to be able to fully utilize engineered wood properties, mill personnel will need information about the specific properties of individual trees that will permit sorting. Needed are reliable, rapid, low-cost techniques for characterizing trees according to desired properties. Opportunities exist for developing such techniques that might be applied at point of harvest or at point of delivery to the mill.

Any modification of wood properties that improve manufacturing process at less cost will be desirable. However, if low cost wood with superior properties for particular uses can be supplied to the mill, it may lead to the development of novel or modified manufacturing capabilities that simplify processes, reduce energy demand, decrease environmental impacts, improve product yields, and/or reduce capital costs.

Any project funded under this solicitation will need to explicitly describe how it can be integrated into the six components outlined above.

Attachment 2

Energy Performance Strategic Platform-Gasification Technology Area

The Forest Products Industry Gasification Initiative
Technical Support Program to Large Scale Demonstrations

Background

The forest products industry has formed an alliance with the US DOE to enable the large scale demonstration of biomass and black liquor gasification. This alliance has the objective of demonstrating at a large scale three different technologies on four different applications. These applications are: high temperature spent pulping liquor gasification applied to kraft; low temperature spent pulping liquor gasification applied to both caustic carbonate and kraft; and low (atmospheric) pressure biomass residual gasification. In all cases the ultimate goal is to operate these gasification technologies in combined cycle with a gas turbine. In order to meet all the needs of the industry and to have technologies available in time to satisfy the aging powerhouse infrastructure, demonstration of all four applications are considered necessary. Success will not only meet the important industry goals of safety, environmental compliance, pulp quality and yield, energy efficiency and capital effectiveness but, of equal or more importance, will make significant contributions to national environmental, global climate and renewable energy goals as well.

The timing of this event is crucial to the industry because the age distribution of its powerhouse structure is such that a large number of boilers will be replaced or significantly modified during the next 10 to 15 years. The gasification combined cycle technologies are needed as a commercial choice during this time period.

This initiative is already organized and underway with the active involvement and support of the DOE. It is crucial that the basic understanding of the processes and supporting technologies are advanced in parallel with the demonstration program so that the chance of successful demonstrations is maximized. The industry and the DOE have had and continue to have a number of important supporting projects but until recently there has not been a concerted effort to organize this project approach into a well thought out and focused support program. The need for this program approach was emphasized at the recent "Technology Summit" and one of the sessions there addressed a path forward.

Utilizing the results of the summit session, a 5+ year technical support program that will maximize the probability of success and where possible accelerate the results of the demonstrations is considered a very high priority by the industry. The most pressing needs must be identified and placed on a track to provide timely results. The credibility and objectivity of information developed will be essential.

Prioritization Process

Realizing the complexity of the task to provide the best technical support program within the constraints of limited resources, a number of experts from the industry, academia and the national laboratories were asked to take the results of the technology summit session and develop a prioritized list of needed information that aligned with a focused set of program areas. The results of this effort identified the program areas of "Fuels Chemistry", "Containment", "Mill Integration Issues" (including steam, power, pulping and causticizing), "Process Control and Optimization", "Assurance and Education" and "Field Support" (project specific) as the necessary areas on which to focus.

Listed below is a brief description of each area. Following the descriptions is information which identify the needs as "Immediate Needs for Demonstration" or "Optimization Needs for Sustainable Performance". All areas are considered important to the ultimate success and economic sustainability of the technologies. Obviously with a demonstration program underway, those needs associated directly with this program are particularly urgent.

Fuels Chemistry

Both black liquor gasification and biomass gasification are technologies that have developed to the point of readiness for large-scale demonstration. However, there are areas of fuels chemistry that require additional technical investigation to complement and support the commercial demonstration program. A directed fuels chemistry technical support effort that provides usable results will maximize the chances of successful demonstrations. Fuel chemistry encompasses all chemical reactions, fluid dynamics, and phase equilibria behavior associated with the fuel, other reactants, transport gas, and gasification products. It also includes potential interactions with vessel refractories, fluid bed media, and heat transfer media. It is generally agreed in the technical community that there is good understanding of global gasification and pyrolytic gasification chemistry.

Historical development has concentrated on this area with less effort applied to understanding the fuel chemistry of minor products and residual solids. Better technical understanding of the formation and destruction of tars (condensable organic compounds heavier than benzene) and their ultimate impact on downstream unit operations will be required for commercial success. Tar destruction efforts may include both catalytic and non-catalytic methods. The potential impact of gasification catalysts, both added catalysts and alkali compounds in the fuel, on tars and residual carbon needs to be understood. An understanding of residual carbon age distribution and composition is needed to optimize reactor design. The window of acceptable operating conditions to provide high carbon conversion without bed agglomeration must be found. The management of contaminants such as sulfur, halogens, nitrogen, and alkalis needs to be understood for process operability, for use of the product gas, and for environmental impact minimization.

To optimize performance of commercial units and reduce risk, it is important to significantly increase the level of knowledge about combustion conditions, fluid dynamics and the impact of unique reactor geometry. For complete understanding of how fuel chemistry affects commercial viability, reaction chemistry, fluid mechanics, and phase behavior should be incorporated into both rigorous and engineering computational fluid dynamic models for use in design and process control. Better understanding of fuel chemistry can also be applied to optimization of specific fuel throughput, e.g., $kg/m^2/s$, to minimize capital cost. A list of fuels chemistry technical support needs is given below.

Fuels Chemistry – immediate needs for demonstration

- Carbon Management

- Tars
  - Tar Destruction (Catalytic and Non-Catalytic)
  - Tar Production
- Residual Carbon (Low Temperature Gasification)

- Halogen Management
- Sulfur Management
- Modeling (e.g. Fluidization, Heat Exchange Interaction, Heat Transfer, Flow and Temperature, Particle Resonance Time)

Fuels Chemistry – Optimization needs for sustainable performance

- Carbon Management
  - Gasification
    - Catalysis
    - Alkali metals effects and management
  - Pyrolysis
- Nitrogen Management
- Specific Throughput

Containment

Experience with the black liquor gasifier at Weyerhaeuser's New Bern, N. C. mill and other experiences clearly indicate that the reactions occurring in the gasification process are difficult to contain and that long term and economically acceptable approaches are yet to be developed. Solutions to the containment issue are seen to involve metals used for reactor shells and in some cases internals, refractory materials used to line the containment vessels, the vessel design itself and significantly increased knowledge about the interaction between the fuels chemistry issues discussed above and reactor design. Whereas the ideal solution may ultimately be materials that are unaffected by the fuel and reaction chemistry, innovative combinations of refractory, metals and vessel design may be necessary to provide acceptable operating up-time and maintenance cost. Modeling and model verification of bed behavior and/or chemical and physical processes occurring inside the vessel is also seen as extremely important in enabling optimum reactor design and the prevention of catastrophic failure. All of these areas are believed to be of high importance as the table below indicates.

Containment – Immediate needs for demonstration

- Metals
- Refractories
- Vessel Design
- Understanding of Internal Reactions and Circulation

Mill Integration - steam, power, pulping, causticizing

There are a number of both positive and negative impacts that gasification technologies will have on the pulp mill. To insure that the demonstration facilities have sustainable operating economics, it is essential that the positive impacts are realized to their fullest and that the negatives are minimized. Perhaps the most exciting areas are the potential impact on pulping itself and on the mill's steam/power balance, although there are significant pluses in the areas of safety, environment and capital effectiveness as well. One troublesome area involves increased load on causticizing, which must either be minimized or eliminated altogether through the incorporation of new innovative approaches. To fulfill the full promise of BGCC and BLGCC, issues with hot gas cleaning and turbine design and integration must be addressed and optimized. The current view of the most interesting technical support needs is shown below.

Mill Integration – steam, power, pulping, causticizing – Immediate needs for demonstration

- Causticizing Load Increase
  - Autocausticizing (High temperature & low temperature)
- Sulfur Recovery

Mill Integration – steam, power, pulping, causticizing – Optimization needs for sustainable performance

- Value of Integrating BLG with Pulping
- Environmental Performance
- Greenhouse Gas Impact
- Criteria Pollutants (NOx, SOx, PM)
- Hazardous Air Pollutants
- Solids Management
- Liquids Management
- Causticizing Load Increase
  - CaO/MgO for H_2S Capture
  - H_2O Quenching
- Hot Gas Cleaning
- Implications for Turbines

Process Control and Optimization

The hallmark of effective process control is the ability to maintain plant performance and emissions at target levels with varying load, fuel properties, and atmospheric conditions. Process optimization represents improvement in process performance based on (generally) incremental changes in design, operation, or control. Examples of projects in this area include: development and design for control systems; dryer/evaporator/heater (such as pulse heater) design and control; development of methods for introducing black liquor into the reactor vessel in controllable and optimal form; sensor development and integration into active process control; and coordination of sub-models developed in all areas of this work into compatible and useful tools, possibly including use of sub-models as part of the control system. Many projects included in this area require intimate coordination with work conducted in other areas and with the A&E/design firms engaged in demonstrations. Areas considered of particular importance are listed below.

Process Control and Optimization – Immediate needs for demonstration

- Pulse Heater Design and Control

- Black Liquor Introduction Control

Process Control and Optimization – Optimization needs for sustainable performance

- Control System Development and Design
- Sensors
- Models Management and Validation

Assurance and Education

Experience has clearly shown that one of the most important elements of success for any technology is a disciplined and thorough approach to assuring that the basis and information on which a plant is designed and operated is accurate. For a new technology, this assurance requires a prudent amount of long duration testing and often an independent verification of critical design data and information. In addition, the level of knowledge of people involved in operating, maintaining, supervising and troubleshooting the facility needs to be sufficient to enable informed decisions at all levels. For a new technology new education and training programs are often necessary. The areas believed to be of most importance to the success of the demonstrations are listed below.

Assurance & Education – Immediate needs for demonstration

- Long Duration Testing and Demonstration
- Independent Verification
- Education
- Environmental Performance Assurance

Assurance & Education – Optimization needs for sustainable performance

- Performance Test Protocol
- Life Cycle Impacts

Project Specific Field Support

The availability of specialized skills, analytical techniques and equipment, people with broad experience in related technologies and other sometimes overlooked areas are often absent from demonstration projects unless specifically provided through field support arrangements with organizations possessing the needed people and/or equipment. The development path of both coal and biomass gasification technologies over the last several years has created some centers of excellence that are capable of supplying this unique support. Some of the areas that should be considered are listed below. The selection of field support needs will be unique to each demonstration project, but it is likely that all projects will require some specialized assistance to maximize their probability of success.

A. **Field Support (**Project Specific**)**

- Trouble Shooting
- HazOps

- QA/QC
- Specialized Measurements
- Design Process Peer Review
- Operating Assistance – Data Collection & Analysis
- Laboratory Support (Methods Development)

Material/Energy Balance Verification

Attachment 3

Significantly Reduced Manufacturing Costs Strategic Platform-Fiber Modification Technology Area

To provide new and enhanced sheet structures and/or lower material costs.

Introduction

All paper grades are very dependent on the attributes of the fibers from which they are made. Certain types of fibers are utilized in particular grades to achieve the most desirable properties. According to calculations using the IPST Economic Model, fiber costs are typically the single largest component of manufacturing costs, ranging roughly from 22% (for newsprint) to 42% (for linerboard). Papermakers often must utilize fibers that are readily available to them at low cost even though these may not always be the most ideal fibers for the grade in question. It would be desirable to be able to modify fibers in such a way that any given fiber could be used effectively in the production of any grade. While this may not be a realistic goal, the ability to modify the bulk or surface properties of fibers, so that they provide new or enhanced benefits or reduced costs, is a very worthwhile objective.

For example, any modifications to fibers that could:

- reduce fiber costs by requiring fewer fibers in a given grade,
- enhance the performance of the grade,
- extend their applicability to other grades, or
- lead to altogether new grades

would be extremely desirable. There are a number of ways that can be used to modify fibers. Most commonly we rely on mechanical methods (refining) to modify the secondary cell wall structure of the fiber to enhance fiber bonding and paper strength. Refining, however, can also have deleterious effects on fiber and paper properties. Today we recognize that there are significant opportunities to develop improved fibers through genetic, chemical, or enzymatic methods that may well lead to new and enhanced web structures. These new approaches to fiber engineering offer significant potential to improve fiber utilization and lower raw material costs.

Fiber Engineering

Paper is unique in that pulp fibers come together during consolidation of the web via surface tension forces and then bond naturally through hydrogen bonding. No adhesive is required to produce a reasonably strong sheet. The strength of the bonding and other web properties, however, depend on a number of factors such as the type of fibers (hardwood *vs.* softwood), fiber morphology (fiber length, coarseness, etc.), the nature of the pulping method (mechanical versus chemical), the extent of fibrillation (perhaps by refining), etc. Some argue that the building blocks of paper are not fibers at all but rather the cell wall material of the fibers. While some strength attribute is a requirement in virtually all paper grades there are other attributes that may play an equal or greater role than strength (for example, opacity, brightness, absorbency, etc.) for which certain fiber properties will be more important than the ability to just develop strength. (It is rather amazing that so many grades of paper, with different end use requirements, can be made from the same fiber type. The diversity of such grades must also be considered when contemplating the engineering of certain fiber attributes.)

The Opportunity

The American Forest and Paper Association has developed a Technology Strategy for the pulp and paper industry based on six platforms or elements:

1. Higher value raw material supply
2. Significantly reduced manufacturing costs
3. Improved energy performance
4. New forest based materials
5. Superior environmental performance
6. Technologically advanced workforce

Fiber Engineering is an integral part of bullets one through four and possibly 5. Enhanced fiber attributes are necessary to deliver higher value and likely will be required to assure new forest based materials. Enhanced fiber attributes, however, are not necessarily sufficient in the case of reducing manufacturing costs. Improved energy performance opportunities are primarily related to mechanical fiber liberation processes. At the recent Technology Summit Meeting, and in follow-up discussions, a number of opportunities have been identified in which successful Fiber Engineering is intimately involved with the success of these other high interest areas. In fact, fiber modification is the key to change in our industry. See Figure 1.

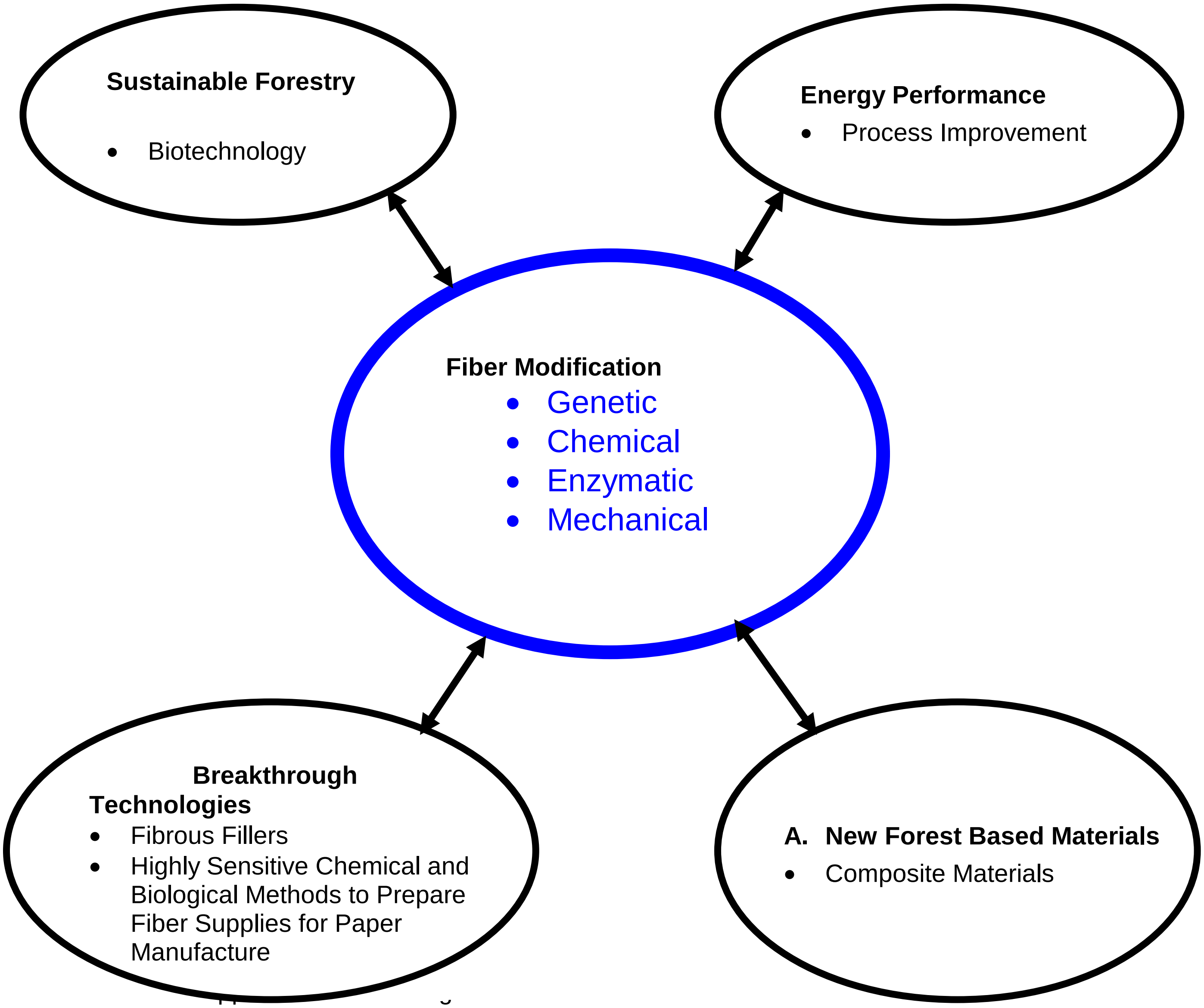

Figure 1: Fiber Modification is the key to change in our industry

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With respect to Figure 1, the desire is to focus on biotechnology in the Sustainable Forestry area, the development of “fibrous fillers” and highly sensitive chemical and biological methods to provide superior fiber supplies in the Breakthrough Technologies area, and composite materials in the New Forest Based Materials area. Clearly, the development of superior engineered fibers must be a high priority for all of these areas.

Approach to Fiber Modification

With the above thoughts in mind the broad goals of Fiber Modification must be to:

- Seek innovative ways to enhance fiber-fiber bonding so that fewer fibers will be required to produce the same sheet strength.
- Seek innovative ways to enhance the performance of fibers in grades where attributes other than just strength are of primary importance
- Seek ways to utilize the fibers developed above in other grades or in completely new grades of paper.

While it will be desirable at some point to engineer fiber attributes for use in specific grades, early fiber engineering work probably should not be too specific.

In general, there are at least three ways we envision that fibers can be “engineered”:

- **Genetic Modification:** This is a long term approach to providing higher fiber value. There is considerable overlap here with the Sustainable Forestry and New Forest Based Materials areas. The primary differentiation between these areas and the Fiber Modification is that the latter is very focused on sheet structure and product attributes. A question that needs to be addressed is ‘What fiber attributes would you attempt to change genetically?’
- **Chemical or Enzymatic Modification:** Either of these approaches to fiber modification may focus on the bulk of the fiber or just the surface of the fiber. For example, could we modify the surface of mechanical pulp fibers so that they behaved more like chemical pulp fibers with respect to bonding?
- **Mechanical Modification:** We know a lot about refining, but clearly there are still things we need to understand. Is it possible to develop separation technologies based on certain fiber characteristics (coarseness, curl, surface energy, etc.) that will allow us to obtain the population of fibers that need treatment. Are there alternate refining methods that could optimize the transfer of energy to the fiber that would enhance and control fiber quality?

For any of these approaches, to fully appreciate the interaction of the three secondary cell wall components and their impact on fiber bonding and web properties, a micromechanical model is needed. Such a model would predict the properties of the fiber as a function of composition, geometry, and architecture, and would provide guidance and opportunities to engineer desirable fiber properties.

A last point is that any modifications to fibers ideally should be low cost. While more expensive treatments may be suitable for new or high value products, high modification costs would not be appropriate for many existing grades.

Fiber Engineering Goals

It is possible to state some *specific* target goals that would have an impact in those areas shown in Figure 1. These target goals cut across all product lines, most of them could lead to lower fiber usage in these products. This, in turn, could mean lower fiber processing costs and lower energy consumption per unit of product, as well as enhanced sustainability of our forests.

- Improve performance to cost ratios for major grades by 50%.
  - Develop lower fiber costs while maintaining performance. This may be achieved by improvement in growth rates or general tree improvement of properties such as wood and fiber yield, wood density, cell wall thickness, or cellulose content. Methods of tree improvement include breeding and clonal selection and genetic engineering of elite clones.
  - Improve performance at constant basis weight. Fiber uniformity could have a major impact on performance. Minimizing differences between earlywood and latewood, for example, could significantly improve both covertibleility and end-use performance of the paper product. Clonal propagation offers some possibilities for enhanced fiber uniformity.
  - Improved performance could also be achieved by improving fiber properties such as length, diameter, and shape as well as optimizing the construction of the secondary cell wall. The latter controls the elastic modulus of the fiber and strongly influences bonding in the case of refined chemical pulp fibers. As noted earlier, micromechanical models of the secondary cell wall that enable us to understand the complex chemical and mechanical interactions between the layers is badly needed.

- Engineer fibers to increase fiber-fiber bonding by 50% with little or no increase in fiber costs
  - Modified pulping and bleaching strategies that retain all of the inherent fiber strength. Eliminating degradation of the fibers is advantageous and could enhance bonding performance as well.
  - Develop chemical and/or enzymatic strategies (bulk or surface) that enhance bonding between fibers. Modification of surface groups that could participate in and enhance fiber-to-fiber bonding has already been demonstrated in some systems.
  - Develop novel mechanical modification strategies that will promote bonding without excessive degradation of the fiber.
  - Genetic strategies to control the secondary cell wall during growth (as referenced above) could also be expected to offer enhanced bonding potential.
- Develop strategies that tailor specific fiber attributes to specific end uses. While we attempt to do this now, clonal strategies to develop superior fiber populations for specific product attributes (for example strength, flexibility, or absorbency) could take us to the next level. Genetic manipulation of fibers to provide superior properties for specific paper grades would perhaps be the ultimate goal.

Request for Proposals

Proposals are sought that would address those Goals stated above. At this time the desire is to place emphasis on Fiber Modification using Chemical or Enzymatic approaches, but proposals in any area of Fiber Modification will be considered.

Attachment 4

Environmental Performance Strategic Platform-VOC and HAP Technology Emission Area

Low Cost Methods are Needed for Controlling VOC and HAP Emissions from Pulp, Paper, and Paperboard Mills and Wood Products Facilities

Background

Current methods for controlling VOC and HAP emissions from pulp, paper, paperboard, and wood products manufacturing are generally effective, but expensive and resource intensive. Furthermore, wood products VOC/HAP control technologies require improvements to their effectiveness.

The Agenda 2020 program is already funding laboratory and pilot-scale research into the use of low temperature plasma technologies for treating VOCs and HAPs from wood products facilities and pulp mills. The initial results suggest the possibility of significant cost and energy savings compared to current thermal oxidation technologies. This represents the type of treatment technology breakthrough that is of continuing interest to the industry. The opportunities are much broader than new treatment technologies, however. There is a need for creative thinking about the myriad possibilities involving, for instance, biotechnology, chemical pathways that convert VOC and HAP precursors to a form that remains with the product, and ways to produce purer, more concentrated forms of specific VOCs that are suitable for sale as by-product chemicals.

The needed work is equally varied. In some cases, biotechnology for instance, the process would have to start with basic and applied research. In other cases, the scientific understanding already exists but what is lacking are cost effective technologies employing already-understood scientific principles. There may even be cases, like the current studies of low temperature plasma technologies, where the gaps will be filled by technology transfer demonstration projects at the laboratory- and pilot-scales.

Several aspects of this challenge have been targeted for examination under the Agenda 2020 program. These are (a) the development of trees with reduced amounts of VOC and HAP precursors, (b) production technologies (perhaps at low temperatures) that minimize the conversion of VOC and HAP precursors, or which use less VOC- and HAP-generating materials, (c) methods to capture VOCs and HAPs that yield competitively priced by-products or fuels, and (d) high efficiency VOC and HAP destruction technologies that are less costly and more resource efficient than thermal oxidation technologies. These technology needs are discussed briefly below. To be widely accepted, the technologies must be capable of cost effective and highly efficient control of methanol, acetaldehyde, formaldehyde, and methyl ethyl ketone and require much less energy to implement.

In chemical wood pulp production, HAPs including methanol, acetaldehyde, and MEK are formed during the digestion process. Methanol is by far the dominant one, and it is generated from the breakdown of methoxyl groups present in lignin and hemicellulose. The amount of methanol generated increases with length and extent of cooking, with the most amounts being formed in during kraft, soda, and sulfite pulp production for bleached pulp. Lesser amounts are formed when kraft pulp is produced for unbleached products, and still less in the production of semi-chemical pulps. Methanol can also be released in mechanical pulping operations due to the high temperature of the grinding or refining process. In the various pulping processes, volatiles present in the extractive component of wood can be released as well. Extractives include terpenes, resin acids, fatty acids, and phenols. These can contribute to VOC releases. Although pulping operations account for the bulk of VOC and HAP generation in a mill, emissions of these compounds can occur from almost any process operation where digester and/or evaporator condensates are reused or weak pulping liquors are evaporated.

In solid wood operations, wood drying will result in release of VOCs, including methanol and formaldehyde, which are also categorized as HAPs. Thermal degradation of lignin, hemicellulose, and cellulose will generally increase as drying temperatures increase, and release of extractives will also increase with temperature and drying time. For an equivalent amount of wood volume, releases will increase with exposed surface area at a given temperature. The resins used in reconstituted wood products and the processes used in pressing have an impact on VOC and HAP emissions.

Trees with Reduced Amounts of VOC and HAP Precursors Might Eliminate the Industry's Need for Costly Emission Control Devices

Although there are bound to be limits on the extent to which trees can be modified to contain small amounts of VOC and HAP precursors, it would be helpful to understand the gains that might be achieved by pursuing this strategy. A first step would be better defining the relationships between the chemical composition of wood and the generation of VOCs and HAPs. These results would help define the potential reductions in VOC and HAP generation that might be achieved by modifying the chemical composition of wood.

It is important to emphasize that the industry has a number of important product quality and competitiveness issues that have the potential to be addressed through changing the basic structure and composition of wood. Any changes made to reduce the VOC and HAP precursor content of wood must, at a minimum, be consistent with these other industry objectives, and ideally should assist in meeting them.

The industry understands that this type of research is time consuming and therefore anticipates that the fundamental research stage of this program could extend to 2010, with deployment of findings at the commercial scale requiring another decade.

Production Technologies are Needed that Minimize the Conversion of VOC and HAP Precursors, or which Use Less VOC and HAP's-Generating Materials

The mechanisms leading to the formation of VOCs and HAPs are discussed above. There may be ways to manipulate the production processes to minimize the extent to which precursors are converted to volatile chemicals or to eliminate volatile organic chemicals from feedstocks, while reducing energy consumption and continuing to produce high quality products.

Much of the fundamental knowledge needed to pursue this avenue has already been developed, but for this particular application, refinements would undoubtedly be needed. For emissions from kraft mills, the disciplines most critical to the work would be pulping chemistry and kraft production processes, and the industry would look to centers of excellence in these areas to pursue the work.

In other types of paper and paperboard production, the HAPs are generated in small lower amounts. Although there is interest in reducing HAP emissions from these sectors of the industry, research in these other sectors is of lower priority than that for kraft mills and wood products facilities, as described below.

Without question, the most urgent environmental issues facing the wood products plants revolve around VOC and HAP emissions and their control. New EPA emission standards will be proposed within the next few months that will require very significant emission reductions from most wood drying and pressing operations at panel plants (softwood veneer dryers, rotary dryers, tube dryers, batch presses, and continuous presses) over the next five years. VOC emissions from softwood lumber drying kilns and engineered lumber manufacturing operations are coming under increased EPA and state scrutiny, although add-on controls have not been mandated to date for any facility.

The drying of wood can release VOC and organic HAPs (primarily methanol and formaldehyde) as the result of thermal degradation of the wood components and the escape of volatile extractives from the wood material. At panel plants and engineered lumber mills, use of resins can result in additional formaldehyde and methanol releases, due to evaporation or thermal breakdown of the resins during pressing operations.

Opportunities may exist to reduce VOC and HAP emissions without the use of expensive, energy-consuming add-on technologies such as thermal oxidizers or biofilters. Modifications to the wood drying process are being explored in current Agenda 2020 projects. Modifications to the conventional high temperature batch pressing process are also being investigated. Lowering of drying and pressing temperatures would have additional benefits in terms of energy consumption and energy-related emissions, i.e., less fuel burning for direct contact drying, and steam or hot oil production. Resin manufacturers have made significant strides in reducing the free formaldehyde content of urea and phenol formaldehyde resins over the last decade, and are working on lowering the amount of methanol impurity in urea formaldehyde resin. Further resin reformulation efforts might be possible that would minimize the release of formaldehyde due to resin breakdown during pressing.

The industry is focused on improving the functionality of its products and on becoming more competitive. Changes made in the production process for purposes of reducing the generation and emission of VOC and HAP compounds must not interfere with the attempts to make progress in these other areas. The ideal solution would allow simultaneous strides in environmental performance, product functionality, energy intensity, economics and competitiveness.

Fundamental changes to the processes used to manufacture forest products are expected to require significant amounts of time. Here one might shoot for theoretical work and initial proof of concept laboratory testing to be completed by 2005. Larger scale laboratory testing and pilot trials could proceed until 2010, with deployment of commercial units by 2015.

Methods are Needed to Capture VOCs and HAPs to Yield Competitively Priced By-Products or Fuels

The HAPs of concern to the chemical pulp industry, methanol in particular, are generated in quantities that suggest that it may be possible to convert these emissions into salable by-products. The primary challenge is finding inexpensive ways of cleaning the captured material to a quality required by the market. The kraft industry already makes extensive use of stream strippers that often yield a concentrated methanol stream. These methanol streams also contain significant quantities of sulfurous organic compounds and other organics (e.g., terpenes) that need to be removed to produce a marketable methanol material.

The VOCs from wood product facilities are more varied because the manufacturing processes vary among wood products. For wood drying, the emissions are dominated by methanol and terpenes. The Institute of Paper Science and Technology (IPST) has been researching ways to capture VOCs generated in wood drying to produce a turpentine product suitable for the market.

VOCs from wood panel plant presses and dryers can include methanol, acetaldehyde, and formaldehyde. The amounts generated, their concentrations and the water content and temperature of the emissions vary greatly from one product to another, among facilities, and from unit to unit. Attempts to produce marketable by-products from these streams will need to address this variability.

Several types of expertise will be needed to address this technology need. First, it is helpful, although not absolutely necessary, to understand the manufacturing processes that generate the compounds of interest from the by-products point of view. More important is expertise in (a) separation techniques appropriate to the compounds and contaminants of interest, and (b) a knowledge of the markets for the materials under consideration. Accordingly, this work could be performed by a wide variety of research groups. Experience in the forest products industry is not required, although proposals should exhibit a knowledge of the types of liquid and gaseous streams being targeted. Proposals involving approaches that make the industry more energy intensive will be at a distinct disadvantage.

A reasonable schedule for this work would allow for laboratory-scale proof of concept work to be completed by 2003, with pilot and filed trials completed by 2005. If successful, a commercial unit would be deployed by 2010.

High Efficiency VOC and HAP Destruction Technologies are Needed that are Less Costly and More Resource Efficient than Thermal Oxidation Technologies

VOC and HAP emissions from the forest products industry, especially from wood products facilities, are often treated by thermal oxidation methods (essentially incineration). The gases most often treated by thermal oxidation are press and dryer vents at panel plants and, less frequently, other wood product emissions and high-volume-low-concentration gases from kraft mills. The gases are relatively dilute (at least compared to the concentrations needed to support combustion) and often high in moisture.

Thermal oxidation technologies require substantial capital investment, involve high operating costs, primarily in the form of natural gas as fuel, and are energy intensive. Therefore, the opportunities for cost and energy savings are substantial. The use of low temperature plasma technologies as an alternative to thermal oxidation is already being explored in an Agenda 2020-funded project, but other low cost methods are also of interest to the industry.

The expertise required to perform the needed research will depend on the technology proposed. In addition, the proposal will need to demonstrate an understanding of the types of emissions targeted for treatment. In cases where the proposal involves a new application for an already proven technology, it is expected that proof of concept research would be completed by 2003, with field demonstrations finished by 2005. If successful, commercial deployment could be accomplished by 2010. Although the industry is not discouraging fundamental research into new control technologies, proposals for work on promising technology transfer opportunities are of primary interest.

Attachment 5

FIVE-PAGE PROPOSAL SUBMITTAL FORMAT

A summary page (one page limit) should be provided in the following format using no smaller than an 11-point Arial or equivalent font type print. **This summary page is not included as part of the 5-pages.**

Agenda 2020 Research Area (i.e., higher value raw materials through sustainable forestry, gasification, fiber modification and VOC and HAP emission)

Project Title:

Principle Investigator: (Include name, organization, mailing address, phone number, fax number, e-mail, and congressional district.)

Partners: (Identify commercial partners and list all sources of financial support. Include name, organization, mailing address, phone number, fax number, e-mail, and congressional district)

Abstract: (Nonproprietary summary of proposed project, including project benefits suitable for public release (maximum of two paragraphs))

Budget Table:

Budget	Total	DOE Share	Cost Share	Source of Cost Share
Total Project				
Year 1				
Year 2				
Year 3…				

The 5-page portion of the proposal must include the following main headings:

1. Project Title
2. Primary Investigator - name, title, company
3. Collaborators - name, title, address, and congressional district
4. Research Area to Which This Work Is Focused (higher value raw materials through sustainable forestry, gasification, fiber modification and VOC and HAP emission)
5. Background
6. Objectives – Specific statement of project goals deliverables.
7. Experimental Approach – Describe research to be conducted. Identify all project participants and discuss the role of each, specific attention must be given to the role and time commitment of the principal investigator. Identify currently available equipment and facilities that will be used in the project and justify additional needed facilities and estimated costs.
8. Quantified benefits to the Industry Should the Research Yield Promising Results – Economic benefits: estimate as quantitatively as possible the expected economic benefits that will accrue to the U.S. forest products industry from completing this project. Identify needed additional steps to bring the research to commercial practice.

Energy benefits: Describe how this research project will either reduce energy consumption in the manufacturing process or will permit substitution of biomass-based materials for non-renewable materials. Attachment 7 must be completed and attached to the application.
Environmental benefits: Describe how this project will reduce overall environmental impacts associated with the wood products industry. Be as quantitative as possible.

9. Schedule, Milestones, Go/No-go decision points including technical targets, and other Measures of Success including a path to commercialization
10. Investigator's and Collaborators' Qualifications - include citations of investigators' key publications most directly related to proposed work (do <u>not</u> attach resumes, publications, or publication lists)
11. Budget – Explain why DOE funds are needed. Include funding level required in each project year using the format provided in Attachment 6. This should be provided as an attachment and will not count as part of the 5 pages.

The size of each section of the proposal should be appropriate provided, however, that the total length of this portion is not more than 5 pages. The following attachments **<u>are required for DOE funding</u>** and do not count as part of the 5 pages:

Industrial Letters of Support
Detailed Budget (see Attachment 6)
OIT Project Performance Metrics Form (see Attachment 7)
Documentation of previously stated appropriate level of cost share (In-kind contributions (e.g., donations of material and labor) are acceptable as cost share, provided realistic dollar values are assigned to such contributions. Sunk costs (e.g., value of previous research) cannot be used for cost share.)

If a proposal is selected for negotiation and includes a DOE National Laboratory participant with unique capabilities, the National Laboratory will receive their funding directly from the DOE via the existing contract between DOE and the Laboratory rather than as a subcontract or work for others agreement. The cost share for the project should be based on a total project cost including the funding requested for the national laboratory.

Baseline data to assist with the OIT Project Performance Metrics Form can be obtained by e-mailing your federal express address to smcqueen@energetics.com.

ATTACHMENT 6

DETAILED BUDGET

DOE contracts require the budget be provided in the categories listed in the tables below. This information submitted as an attachment to your 5-pager would be useful in proposal evaluation.

Total Budget	**Total Project**	**DOE Request**	**Cost Share**
Direct labor			
Fringe benefits			
Supplies			
Travel			
Materials			
Equipment			
Construction			
Contractual			
Other direct			
Total Direct			
Indirect			
Total Project			

Budget	**Year 1 Total**	**Year 1 DOE Share**	**Year 1 Cost Share**	**Year 2 Total**	**Year 2 DOE Share**	**Year 2 Cost Share**	**Year 3 Total**	**Year 3 DOE Share**	**Year 3 Cost Share**
Direct labor									
Fringe benefits									
Supplies									
Travel									
Materials									
Equipment									
Construction									
Contractual									
Other direct									
Total Direct									
Indirect									
Total Project									

ATTACHMENT 7

OIT PROJECT PERFORMANCE METRICS

1. Technology Description

A. Please provide a concise ***narrative description*** (no more than one-half page) of the new technology you are proposing, addressing:

- Its function, and benefits to the industrial user of the technology
- The state-of-the-art technology it replaces
- The goal(s) of the project
- Potential limitations or barriers to the technology application
- Plant modifications necessary to incorporate the technology (will the technology retrofit an existing system or totally replace existing technology?)
- Known competing technologies (current or emerging)

B. Define ***one unit-year*** of operation (What is a typical process unit? What is the typical unit capacity? (e.g., tons/year/unit, million Btu/year/unit, size of one plant or process using the new process/equipment/model, etc.))

C. Estimate the ***equipment lifetime*** (in years):

D. Will using the technology/process involve a ***retrofit*** of existing technology/process or a ***replacement*** of a unit operation or plant section? (***please explain)***

E. Estimate the ***initial capital cost*** (equipment + installation) of one ***new*** technology unit: ______________ and one ***current*** technology unit

F. Estimate the annual ***non-energy variable costs*** associated with the ***new*** _____ and ***current*** _____________ technology unit.

2. Market Assessment

A. Estimate ***number of installed units in U.S. market*** (total number of units or applications that are currently in use)

B. Estimate ***ultimate potential market share*** (the maximum size of the market, as a percentage, in which the technology or process would be applicable)

C. Estimate the ***likely technology market share*** (the percentage of the potential market that the technology is likely to capture, given competing technologies, etc.)

D. Estimate the ***year of commercial introduction*** (the year in which you expect the first unit to be in commercial operation)________________________

E. Estimate the ***time to total market saturation*** (5 to 40+ years)

3. Energy Consumption (*per unit-year of operation)*

Please complete the following table, basing your estimates on **one unit-year** of operation. As indicated below, physical units are preferred, but you may also provide your estimates in terms of Btu consumed (PLEASE NOTE UNITS AND UNIT SIZE FOR EACH FUEL TYPE, IF DIFFERENT FROM THAT SHOWN IN TABLE).

Fuel Type	**New Technology**	**Current Technology**	**Comments**
Annual Unit Energy Use (in physical units)			
Electricity (million kWh)			
Natural Gas (million cubic feet)			
Petroleum (million barrels)			
Steam Coal (million short tons)			
Black Liquor (thousand tons)			
Other (please specify)			

4. Non-Energy Related Environmental Impacts (*per unit-year of operation)*

Please complete the following table, basing your estimates on **one unit-year** of operation. (PLEASE NOTE UNITS AND UNIT SIZE FOR EACH EMISSION TYPE, IF DIFFERENT FROM THAT SHOWN IN TABLE).

Non-combustion Related Emissions	**New Technology**	**Current Technology**	**Comments**
Annual Non-Combustion Related Emissions (metric tons/unit-year)			
CO_2 (expressed as metric TCE)			
Other greenhouse gases (CH_4, HFCs, CFCs)			
SO_2			
NOx			
Particulates			
VOCs			
Hydrocarbons			
CO			
Toxic (TRI) (please specify)			
Hazardous (non-TRI) (please specify)			
Non-Hazardous Solid Waste (RCRA) (please specify)			
Other (please specify)			

TCE = tons carbon equivalent ($44C0_2$/12C